RE-EXAMINATION OF *ARCHAEICHNIUM*, A FOSSIL FROM THE NAMA GROUP

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(With 3 figures)

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ABSTRACT

The fossils described by Haughton in 1960 as Archaeocyatha from the Nama Group were later, after the study of plaster casts, considered as worm tubes or worm burrows by the present author and named *Archaeichnium haughtoni.* The type specimens have now been re-examined. They consist of agglutinated sand grains and are similar to tubes made actively by living polychaete worms. They are not closely similar to the partly calcareous tubes of *Cloudina* or to the distinctively structured *Volborthella.* In the absence of any taxonomically significant characters of tube construction the systematic position of the originator of these fossils remains uncertain.

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INTRODUCTION

Haughton (1960) described what he considered 'An archaeocyathid from the Nama System', from two specimens (housed in the South African Museum) of a quartzitic sandstone on Gründoorn near the Ham River, 'a typical member of the Kuibis beds'. Germs later re-examined the stratigraphy of the Nama Group. From his brief description of the eastern area it appears that Haughton's fossils came from the Upper Clastic Member of the Nababis Formation, probably corresponding to the Upper Clastic Member of the Kuibis Formation in the west (Germs 1972*a*: 19, figs 14, 22). The interpretation of these fossils hinges on their mode of fossilization. It is therefore necessary to summarize Haughton's views on this matter. He considered them as moulds on bedding planes and noted correctly that some of the supposed moulds are 'marked off' by a bordering depression and that some are lying parallel to each other, as if deposited by current action. They are described as elongated tubular cones with circular cross-sections. 'The more complete individuals have a pointed lower end.' In two

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instances, 'two individuals appear to have been joined at this pointed end'. Haughton noted also the presence of a number of elongate (longitudinal) 'pustulate ridges' and of an individual 'mould' appearing as an approximately circular ridge which 'can be interpreted as an infilling of the intervallum or space between the internal and external walls of a cup, or as a replacement of a single thick exoskeleton'. The second alternative was abandoned without further comment and the first one adopted. Thus the longitudinal section (as seen below the centre of Fig. 1) was interpreted as showing an infilling of a central cavity surrounded by concentric inner and outer walls which are now indicated by depressions. The solid specimens being considered as internal moulds, the present longitudinal ridges on their outer surfaces were thought to separate what would have been broad, rounded ridges on the inner surfaces of the vanished outer walls. If pustules are now present, they would have originated as rows 'of evenly spaced pores' in longitudinal channels. This reconstruction of the fossils from their supposed 'moulds' led Haughton without much difficulty to his interpretation as Archaeocyatha.

The obvious significance of Haughton's classification of his fossils for the dating of the Nama Group led to their re-examination (Glaessner 1963). Those studies were based on plaster casts of the originals. It appeared that the fossils represented infillings of cemented tubes made, probably, by worm-like animals which incompletely agglutinated the sediment surrounding their burrows. The tubes were considered as generally cylindrical but they appeared to be conical where they entered the rock matrix. The specimen (below the centre in Fig. 1, marked M in Glaessner 1963, pl. 3 (fig. 1)) which Haughton saw as two individuals joined at their pointed ends, represents one tube dipping from the bedding plane into the rock matrix and re-emerging with a 90° change in direction. The other specimen, marked with an arrow on Haughton's Plate 4 (L in Glaessner 1963, pl. 3 (fig. 1)), shows a similar change of direction. The number of longitudinal ridges was correctly described by Haughton as ten to twelve on each individual. Five to six ridges can be seen on one side but the supposed pustules are sand grains. The ridges are also visible on several fragmentary specimens but appear only faintly at the ends of the largest specimen. The longitudinal ridges on the outer surfaces of the agglutinated tubes and the transverse layering of the 1 mm thick walls appear to be diagnostic for these fossils. None of the distinctive characters of the Archaeocyatha can be seen in them. There are no pointed cones, no traces of a former calcareous double wall, no septa or other intervallum structures. There is no evidence of an intervallum.

The description of the partly agglutinated tubes of *Cloudina* by Germs (1972*a*, 1972*b*) and recent studies of this genus and of the fully agglutinated *Volborthella* (Glaessner 1976) suggested that a re-examination of *Archaeichnium* would be desirable, not because they could still be considered as Archaeocyatha or as identical with *Cloudina*, as subsequently suggested by Kaever & Richter (1976: 30), but because more is now known about early tube-building worms. The observations of the morphology of these fossils made previously on plaster

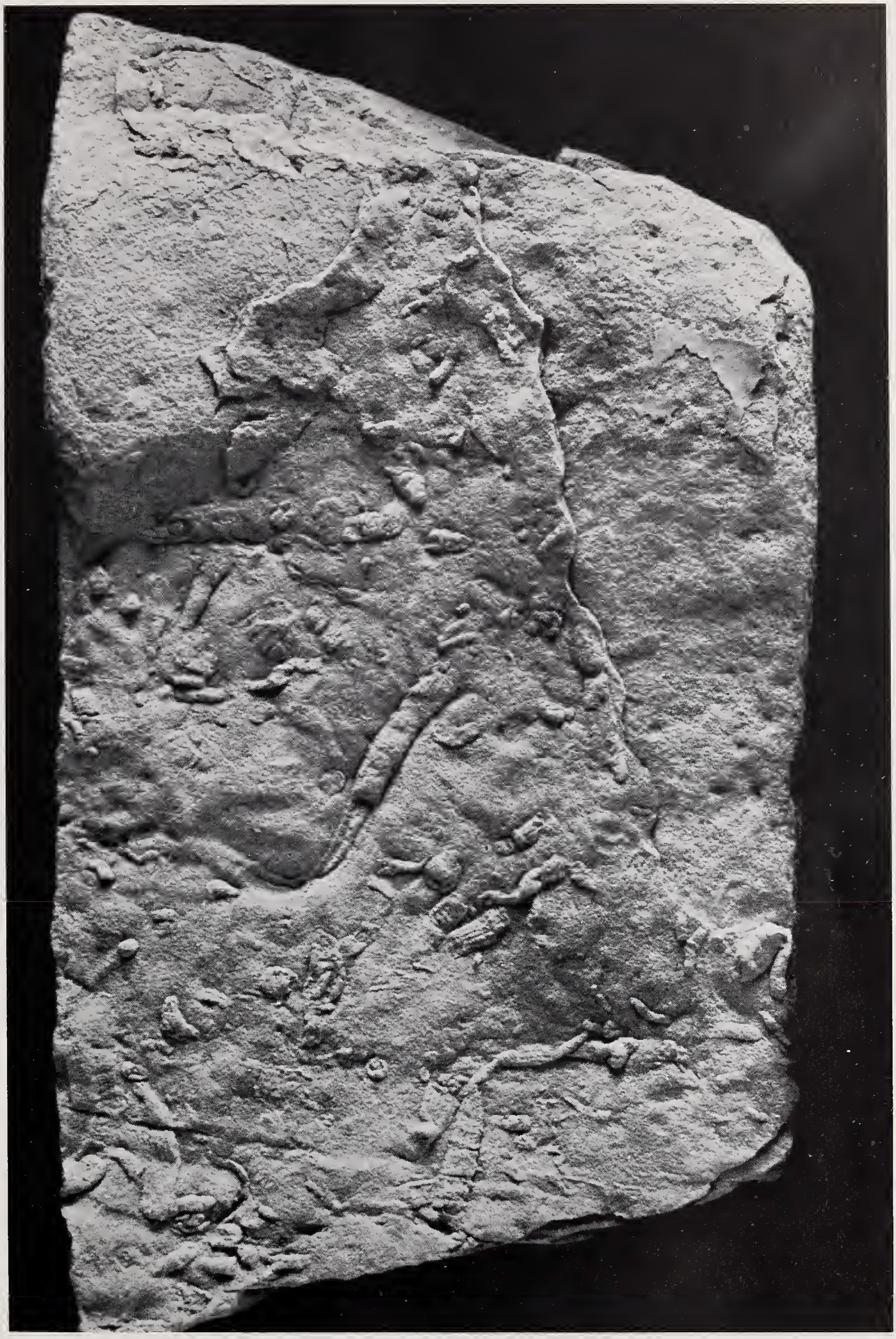

Fig. 1. *Archaeichnium haughtoni* Glaessner, 1963, on a slab of quartzite from the Nama Group (Late Precambrian). Slab B, SAM–K4812. The holotype is the specimen below the centre of the figure. Natural size.

casts have been supplemented by examination of the original specimens. One of them is marked Slab A, SAM–K4813, referred to correctly as Slab A by Haughton (1960) on pages 57 and 58, but as Slab B on plate 3 (true magnification × 0,9, not 'above natural size'). The other is marked Slab B, SAM–K4812, which is correctly referred to by Haughton on pages 57 and 58 and on plate 5, but as Slab A on plate 4. The true magnification of this plate is about × 1,5, not × 5/8. Part of a plaster cast of Slab A was previously figured (Glaessner 1963) as plate 3, figure 2, and part of Slab B as plate 3, figure 1 and they are now shown as Figures 1 (Slab B) and 2 (Slab A).

NEW OBSERVATIONS

The fossils consist of firmly cemented sand grains, mostly quartz. Although the slabs could not be cut and without sections no measurements could be made, the grains forming the tubes appear to be slightly coarser and more uniform than the matrix. They must have been agglutinated prior to fossilization as they are mostly sharply delimited from the matrix and do not grade into it on the bedding planes. There is no indication of any previous presence of thin 'walls' between the matrix and the fossils. The rock slabs consist of a slightly glassy quartzite. Diagenetic alteration of a sandy layer has fused the tubes with the sediment represented by the slabs, leaving them projecting in sharp semirelief from one bedding plane. On the analogy of similarly preserved Australian fossils collected *in situ*, this bedding plane was probably underlain by a silt or clay layer. The preservation is likely to be in hyporelief. On Slab A (Fig. 2) and possibly also on Slab B (Fig. 1) where numbers are smaller, the tubes show (as Haughton had recognized) a preferred orientation, indicating some current sorting. This is demonstrated by Figure 3. Sizes of the tubular fossils range from 1 mm to almost 5 mm in diameter. There is some flattening and some apparent twisting of tubes. Some are cylindrical, some appear to be barrel-shaped, some were probably conical and a few, including one near the bottom of Figure 1 (L in pl. 3 (fig. 1) in Glaessner 1963) thin abruptly at one end to form a long, thin, twisted tail. Irregular forms are more common than geometrically regular ones. Some ends are sharp, others fade out in the matrix. Few if any clean breaks which would indicate brittleness are visible and it is concluded that the tubes were compressible and flexible, particularly where their walls were thin.

INTERPRETATION

In 1963 it was demonstrated that the fossils could not be considered as Archaeocyatha. What are these fossils? Specimen M (Fig. 1, below centre) was selected as the holotype of *Archaeichnium haughtoni* because it shows the most distinctive characters of the new monotypic genus which are seen less clearly among the other fossils on the two slabs. The holotype specimen can be followed in appropriate lighting conditions over a length of 70 mm, almost to the edge of

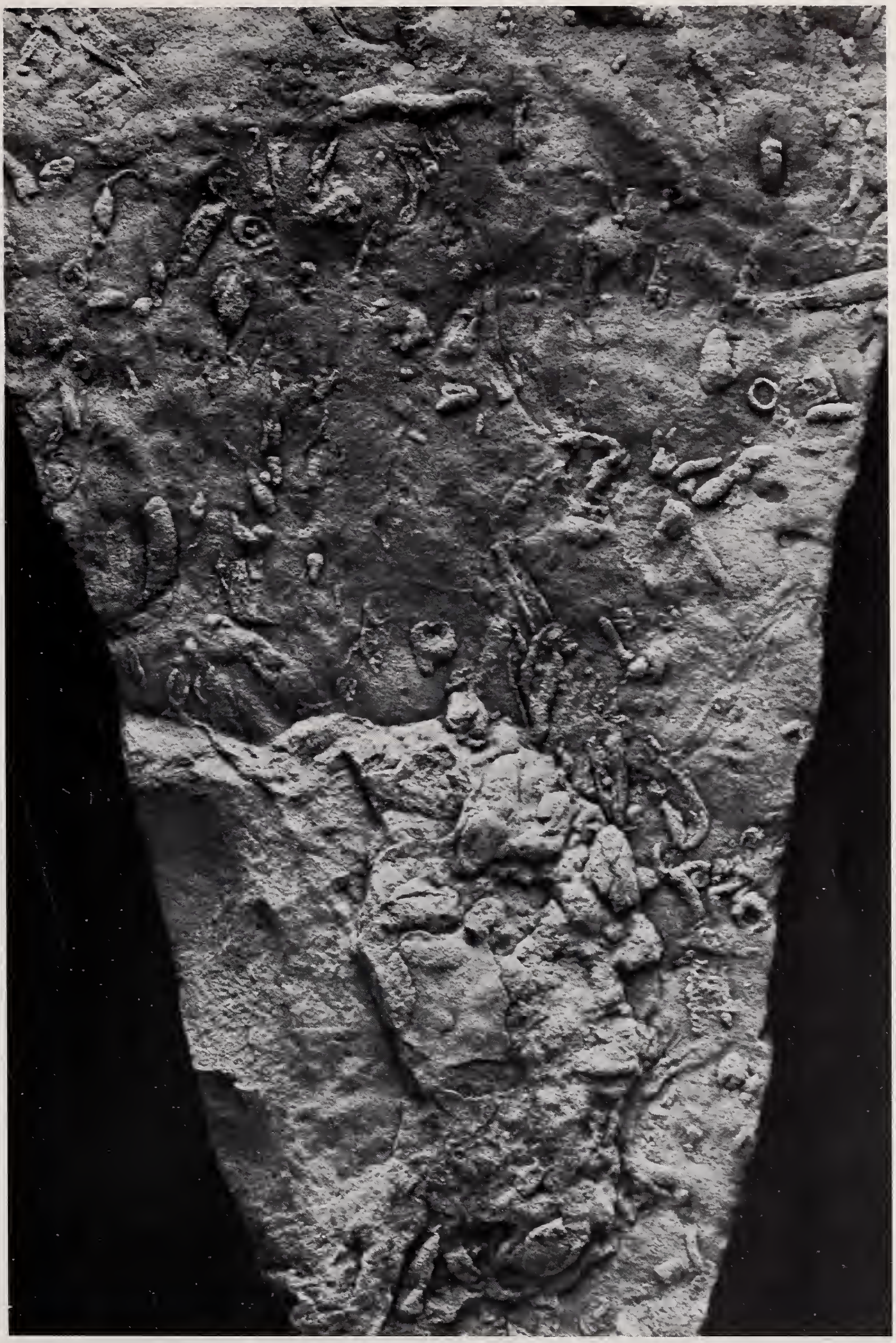

Fig. 2. *Archaeichnium haughtoni* Glaessner, 1963. Slab A, SAM–K4813. (The lobe projecting from the lower part of the bedding plane may be a bioturbated load cast.) Natural size.

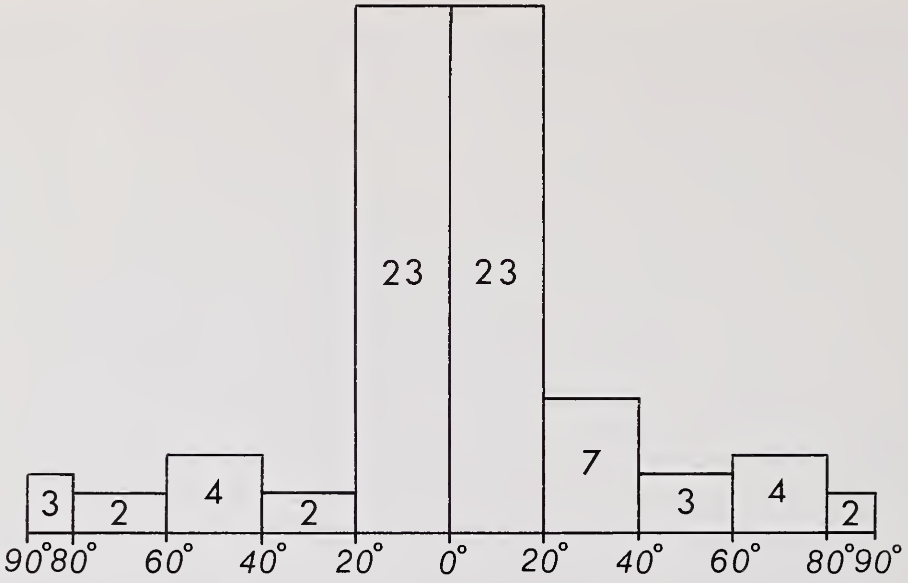

Fig. 3. Histogram of positions of 73 individual fossils on Slab A showing deviation of long axis from modal direction.

the slab. Its maximum width is almost 5 mm. Its wall is about 1 mm thick and shows pronounced transverse layering of sand grains. The centre of the tube is filled with sand grains which show a much fainter and less regular transverse fabric. The outer surface of the tube is marked with fine longitudinal ribs, but they are visible in this specimen only faintly near the ends of the tube, which is either smoothed by weathering or split open for most of its length. At the end nearer the edge of the slab the ribs are preserved as impressions in the matrix, hence they are an external sculpture, not part of an internal mould. In the other large specimen (bottom of Fig. 1, L in pl. 3 (fig. 1) in Glaessner 1963) the external ribs are well preserved and straight but its internal structure is not revealed. This tube is 35 mm long and up to 4,5 mm wide. At one end it is narrowed and appears twisted. Several other specimens show some of these characters such as external longitudinal ribbing or transverse wall fabric. Their size ranges fit those of the larger specimens and the indications of original flexibility are similar. On these grounds the author sees no reason to distinguish any specimens taxonomically from the typical ones.

It is difficult to decide whether these fossils are burrows in the strict sens of the word. There is no doubt that they were built by a worm-shaped animal from sand grains selected and agglutinated by some organic cement which allowed them some flexibility. The clear separation between the tube walls and the matrix brought out by weathering of the bedding plane indicates that the composition of the walls was different from that of the matrix. The wall material appears to have been actively selected by the animal. There is no evidence for calcareous walls having been dissolved during fossilization. The selection of grains and their arrangement so as to form external and possibly strengthening ridges shows active building from transported grains, rather than passive cementation of a burrow wall from grains of matrix *in situ*. Faint transverse texture of the infilling of the tube in the holotype specimen may indicate active filling, but there is no confirmation from other specimens. It is likely that the tubes were made by organisms burrowing in or living on the sediment and constructing agglutinated walls from sand grains. It is also probable that subsequent current action as indicated particularly by the orientation of burrow fragments on Slab A washed the weakly cemented burrows or tubes out of a layer of sediment and distributed them over a bedding plane. If this were the case, it raises the semantic point whether we are dealing with trace fossils in the strict sense of the word or whether worm tubes agglutinated from sand grains with organic cement are properly considered as body fossils, but this is not a matter of substantial importance. The Slabs A and B are so similar that they may well represent not very distant parts of the same bedding plane, yet one (A) indicates current action while the other (B) may be thought to have at least the two curved, long tubes preserved *in situ*. These questions cannot be solved without further field studies and discovery of material *in situ*.

CONCLUSIONS

Archaeichnium haughtoni is a name given to tubular fossils with walls agglutinated from small detrital quartz grains. The best preserved of these tubes show external, longitudinal, straight, fine ribs and a transverse layering of the grains forming the wall. They may have been actively infilled. Most of the tubes seem to be fragments washed out of the original sediment within or from which they were built. They appear to have been redeposited on bedding planes where they were subsequently buried by layers of sand and diagenetically fused with it. There is no significant resemblance between this fossil and others from the Nama Group or indeed from anywhere else. After this study had commenced, Kaever & Richter (1976) described *Buschmannia roeringi* from the Buschmannsklippe Formation of the Nama Group as Archaeocyatha. The author was able to re-examine this fossil. Its resemblance to *Praesolenopora* Tsao & Zhao, 1972, from the Late Precambrian (Upper Sinian) of China (see Tsao & Liang 1974) was noted and it was concluded that it is probably a calcareous alga. *Archaeichnium* differs from *Cloudina* Germs from the Nama Group (Germs 1972*a*, 1972*b*). This genus builds partly calcareous, secreted tubes with only minor, external agglutination of sand grains and transverse sculpture. 'The tube walls seem to have contained organic material. Their distortions suggest some flexibility . . . reminiscent of some agglutinating foraminifera with walls of quartz or carbonate grains and much organic cement' (Glaessner 1976: 266). *Cloudina* is generally placed in the Order Cribricyathida, most of which are of early Cambrian age. Their morphological characters make probable their 'possible relation to the serpulids' (Germs 1972*b*: 753) and suggest that they are 'best classified as an extinct Order of the Class Polychaeta' (Glaessner 1976: 268). *Archaeichnium* differs from *Volborthella* which is built from invaginated cones of agglutinated sandy material round a central tube in distinctly sloping layers, and from the similar but predominantly calcareous *Salterella*. This mode of tube construction is similar in some detail to that used by living Sabellariidae. *Volborthella* can be considered as the product of polychaete annelid worms. While the tubes and the inferred tube-building activities of *Archaeichnium* are comparable and compatible with those of polychaete worms of the Order Terebellida (and probably others), there is as yet nothing sufficiently specific in the known morphological characters of this fossil to support its definite systematic assignment to the Annelida Polychaeta. It can only be tentatively attached to them and must remain for the present *incertae sedis*. No occurrences of this fossil other than that at its type locality, in strata considered to be of Late Precambrian age, are known.

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